

EUROBRISA: A EURO-BRazilian research network for **Improving South American** seasonal climate forecasts

Programme Summary

A Context and aim of the programme

Seasonal climate forecasts are forecasts of the expected climatic conditions in the forthcoming 3-6 months. Improvement in seasonal climate forecasts is a key issue for helping countries reduce losses due to weather and climate risks.

In South America, seasonal climate forecasts already benefit governmental decision-making in several key areas such as energy production, agriculture, and water resources planning to minimize human and economical losses caused by extreme climate events (e.g. droughts and excessive rainy periods). For example, seasonal forecasts of rainfall are used for decision-making in hydropower electricity production in South America. Hydropower accounts for the major source of electricity production in several South American countries: 60% in Bolivia, Brazil, Colombia, Paraguay and Uruguay; and 40% in Argentina, Chile, Ecuador, Peru and Suriname. Improved seasonal rainfall forecasts would help South American governments to better manage these carbon-friendly electricity production programmes – a strategic element in the reduction of global greenhouse gas emissions. In addition, the economies of South American countries also depend heavily on agriculture, an activity which can also benefit from higher quality seasonal climate forecasts. Improved seasonal climate forecasts could thereby clearly benefit the 370 million people who live in South America.

Due its location eastward of the central Pacific ocean, South America is strongly influenced by the El Niño phenomenon and so has a climate that can be predicted with moderate skill 1-2 seasons ahead. However, forecast skill is usually found over specific regions such as north/northeast Brazil, northeast Argentina, Paraguay, Uruguay and south of Brazil. Forecast skill heavily depends on the season of the year with some seasons more predictable than others. Seasonal climate forecasts in South America are currently produced by the Brazilian Centre for Weather Prediction and Climate Studies (CPTEC) based near to São Paulo. CPTEC uses a global computer model that simulates atmospheric conditions using both observed sea surface temperature boundary conditions and statistically predicted Atlantic sea surface temperature. Another approach taken by CPTEC is to use a statistical computer model to produce forecasts for some regions in Brazil. However, both these approaches use rather old technology (more than 10 years old), which do not fully take into account recent advances in climate science, namely in coupled ocean-atmosphere modelling or statistical combination/calibration of multi-model ensemble forecasts (i.e. a large group of forecasts produced by different computer models that is useful for quantifying forecast uncertainty). There is much scope for improving seasonal

forecasts in S. America by implementing scientific developments recently developed in Europe.

The ambitious and innovative aim of the proposed network is to improve the quality of seasonal forecasts for South America.

Specific network objectives are to:

- Strengthen collaboration and promote exchange of expertise and information between European and South American climate scientists/forecasters;
- Produce improved seasonal climate forecasts for South America using recent scientific advances in both coupled ocean-atmosphere modelling and statistical calibration and combination of multi-model ensemble forecasts;
- Develop forecast products for non-profitable governmental use in South America (e.g. reservoir management, hydropower production, and agriculture).

B Description of the institutions involved

The proposed network will comprise the following institutions:

- University of Exeter (UE), U.K. (*lead/coordinating institution*)
- Centre for Weather Prediction and Climate Studies (CPTEC), Brazil
- European Centre for Medium-range Weather Forecasts (ECMWF), UK.
- U.K. Met Office (UKMO), Exeter, U.K.
- Météo-France (MF), Toulouse, France
- Federal University of Paraná (UFPR), Brazil
- Brazilian National Institute of Meteorology (INMET), Brazil
- University of São Paulo (USP), São Paulo, Brazil

The network will bring together a multi-national team of partners having a wide range of complementary and well-established expertise. Professor Stephenson at the University of Exeter has more than 15 years of expertise in statistical climatology and will contribute to statistical calibration, combination and verification of the multi-model forecasts. ECMWF, the UK Met Office, and Météo-France have much expertise in operational seasonal climate forecasting and will freely provide the latest state-of-the-art coupled model seasonal forecasts. CPTEC is the leading climate forecast institution in South America and has expertise in issuing seasonal forecasts over South America. CPTEC will be responsible for combining and calibrating the forecasts from the European partners and for disseminating them freely to all governments in South America via the internet. The Federal University of Paraná (UFPR), one of the key institutions in the Brazilian electricity production programme, will use its hydrology expertise to develop a stream flow forecasting system for use in hydropower decision-making. The U.K. Met Office will also collaborate on development of forecast products for applications in hydroelectric power generation.

The Brazilian National Institute of Meteorology (INMET) will produce forecast products from the climate forecasts suitable for agricultural activities over selected regions of Brazil. The Department of Atmospheric Science at the University of São Paulo (USP) will use its expertise in climate dynamics to study seasonal predictability over South America and also produce seasonal predictions for governmental activities in the heavily populated southeast region of Brazil.

C Significance of the programme

The proposed network will establish an unprecedented world-leading operational seasonal forecasting system for South America, which would be impossible without the network. The new system will produce the best possible forecasts by using the latest multi-model approaches to combine an ensemble of predictions from state-of-the-art coupled models with predictions from the existing South American forecasting systems. The latest multi-model statistical approaches recently developed by the principal applicant, Professor Stephenson (U. of Exeter), and Dr. Coelho (CPTEC), will be used operationally to combine and calibrate the forecasts. The network will integrate seasonal climate forecasting, hydrology and hydropower and agricultural production activities. This work will, therefore, move beyond the incremental development of a single discipline.

This network will enable the South American partners to implement and develop the latest seasonal forecast products produced using state-of-the-art climate forecasting systems in the UK and the rest of Europe. This will provide unprecedented local knowledge and feedback that will help contribute to research progress in seasonal climate forecasting in the UK. This useful real world application will drive the advancement of improved methods for combining and calibrating climate forecasts and so will further the research progress of the UK team. It will also produce an internationally unprecedented multi-model seasonal forecasting system.

The network will be coordinated by Professor Stephenson, who from 1 April 2007 will be based at the School of Engineering, Computer Science and Mathematics, University of Exeter. The network will provide a significant contribution to new climate activities that are starting up at the U. of Exeter in close collaboration with the nearby Met Office. Coordination of this ambitious yet feasible and timely network will put the UK on the leading edge of seasonal forecasting and will provide the UK partners with invaluable local feedback on what research is needed to further improve climate forecasts. The network will help progress UK scientific research in multi-model climate forecasting and its applications. The joint effort of all partners will result in the world-leading operational seasonal forecasting system that combines the best of both statistical and coupled model forecast information in a single forecast. This flagship effort will create impressive and lasting research collaboration between UK and South American climate scientists, which will be enormously facilitated by the network.

Staff schedule

a) Principal Applicant and proposed named partner(s): details of the commitment of each participant to the programme.

Prof. David B. Stephenson (Principal Applicant), University of Exeter, School of Engineering, Computer Science and Mathematics (UK):

- Overall coordination of the network assisted by the Network Facilitator
- Expert advice in the statistical calibration, combination, and verification of forecasts

Dr. Caio A.S. Coelho (Partner), Centre for Weather Prediction and Climate Studies (CPTEC, Brazil):

- Develop and implement a calibration and combination procedure for producing the best quality seasonal climate forecasts for governmental activities in South America
- Act as the S. American point of contact for the Network.

Dr. Francisco J. Doblas-Reyes (Partner), European Centre for Medium-Range Weather Forecasts (ECMWF):

- Provide real-time seasonal forecast data from ECMWF coupled model forecasting system

Dr. Richard Graham (Partner), United Kingdom Met Office (U.K. Met Office):

- Provide real-time seasonal forecast data from U.K. Met Office coupled model forecasting system
- Collaborate on the development of forecast products for applications in S. American hydropower production

Dr. Michel Déqué (Partner), Centre National of Recherches Météorologiques (Météo-France):

- Provide real-time seasonal forecast data from Météo-France coupled model forecasting system

Dr. Alexandre K. Guetter (Partner), Federal University of Paraná (UFPR - Brazil):

- Develop a seasonal stream flow forecasting system for use in hydro-electric power production forecasting
- Perform diagnostic studies of hydrologic extreme events

Dr. Antonio D. Moura (Partner), Brazilian National Institute of Meteorology (INMET):

- Research on the use and value of the combined and calibrated forecasts in agricultural activities

Dr. Tércio Ambrizzi (Partner), University of São Paulo, Department of Atmospheric Science (USP, Brazil):

- Theoretical and observational studies of seasonal predictability
- Production of regional seasonal predictions for southeast Brazil

c) Names and positions of all visitors (other than partners)

None identified at time of writing.

d) Names and positions of advisors, steering committee members, and other staff who would be involved in the programme.

Dr. Tim Palmer, Head of the Predictability, Diagnostic and Seasonal Prediction Section, European Centre for Medium Range Weather Forecasts (ECMWF)

Dr. Franco Molteni, Head of Seasonal Forecasting, European Centre for Medium Range Weather Forecasts (ECMWF)

Dr. Magdalena A. Balmaseda, Senior climate researcher, European Centre for Medium Range Weather Forecasts (ECMWF)

Dr. Timothy N. Stockdale, Senior climate researcher, European Centre for Medium Range Weather Forecasts (ECMWF)

Dr. Andrew Colman, Senior climate researcher, U. K. Met Office.

Dr. Maria A.F.S. Dias, Director, Centre for Weather Prediction and Climate Studies (CPTEC)

Dr. Iracema F. A. Cavalcanti, Senior climate researcher, Centre for Weather Prediction and Climate Studies (CPTEC)

Dr. Luciano P. Pezzi, Climate researcher, Centre for Weather Prediction and Climate Studies (CPTEC)

Dr. Paulo S. Lucio, Senior researcher, Brazilian National Institute of Meteorology (INMET)

Dr. Pedro L. S. Dias, Lecturer/Senior climate researcher, Department of Atmospheric Sciences, University of São Paulo (USP)

Dr. Reinaldo B. Silveira, Senior climate researcher, Brazilian National Institute of Meteorology (INMET)

e) Network facilitator (A UK/EU Phd Student)

With support from Prof. Stephenson and Dr Coelho, the student will help facilitate the network and promote interactions, knowledge and data transfer among the multi-national set of participating institutions. This will require a combination of research and administration that will include:

- developing statistical methodology for the calibration and combination of seasonal climate forecasts;
- evaluating the skill of ECMWF, U.K. Met Office and Météo-France seasonal climate forecasts over South America and provide feedback on this to partners;
- assisting Prof. Stephenson co-ordinate the network so that the planned activities are performed accordingly by each partner;
- organising research workshops for the network and producing annual reports of the work produced by the network;
- visiting European and Brazilian network partners to foster collaboration.